UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KAZUO NAKAMURA, KENJI HORIUCHI, SATOSHI YAMASHITA and KAZUHIRO KATAOKA

Appeal No. 2005,1458
Application No. 09/732,799

ON BRIEF

Before WARREN, KRATZ and DELMENDO, Administrative Patent Judges.
KRATZ, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's refusal to allow claims 17-19 and 21, which are all of the claims pending in this application.

BACKGROUND

Appellants' invention relates to a boron doped diamond product and a method of manufacturing same. An understanding of the invention can be derived from a reading of exemplary claims 17 and 18, which are reproduced below.

17. A single crystal diamond p-type semiconductor having a thermal conductivity of from about 26-31 W/cm°K and consisting of at least 99.5% isotopically pure ^{12}C or ^{13}C and boron in an amount not exceeding 100 ppm.

18. A method of manufacturing a single crystal diamond p-type semiconductor having a thermal conductivity of from about 26-31 W/cm°K and a boron content not exceeding 100 ppm comprising the steps of:

providing a carbonaceous material containing isotopically purified ^{12}C or ^{13}C;

providing a flux containing a nitrogen getter;

adding boron into the carbonaceous material or/and the flux, or around the carbonaceous material and the flux; and

diffusing the carbonaceous material into the flux under a high temperature and pressure to form a boron-doped single crystal diamond p-type semicconductor on a seed crystal diamond.

The prior art references of record[1] relied upon by the examiner in rejecting the appealed claims are:

Tsuji et al. (Tsuji)	5,328,548	Jul. 12, 1994
Anthony et al. (Anthony)	5,451,430	Sep. 19, 1995

[1] The examiner also refers to another reference at page 3 of the answer as representing prior art of record. However, the examiner does not rely on that other reference in rejecting the claims. Thus, we do not consider that other listed reference in assessing the propriety of the rejection before us.

Claims 17-19 and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tsuji and Anthony.[2]

We refer to the brief and reply brief and to the answer for a complete exposition of the opposing viewpoints expressed by appellants and the examiner concerning the issues before us on this appeal.

OPINION

Having carefully considered each of appellants arguments set forth in the brief and reply brief, appellants have not persuaded us of reversible error on the part of the examiner in rejecting product claim 17. Accordingly, we will affirm the examiner's rejection of claim 17 for substantially the reasons set forth by the examiner in the answer and as further discussed below. We reverse the examiner's rejection of method claims 18, 19 and 20. Our reasoning follows.

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[2] The examiner's reference to claims 22-32 as rejected claims at page 3 of the answer is taken as a word processing or typographical error. Similarly, the examiner's reference to claim 23 at page 4 of the answer and claims 23 and 27 at page 6 of the answer are construed as repetitive errors that do not prejudice appellants. In an advisory action mailed April 17, 2003, the examiner noted that claims 17-19 and 21 remain rejected and indicated that an amendment after final (ostensibly the second after final amendment filed April 01, 2003 that canceled claims 20 and 22-32) would be entered. See page 1 of the supplemental brief filed April 01, 2003 under the caption "STATUS OF CLAIMS."

Tsuji is concerned with the good heat conduction properties of diamond that has lower amounts of carbon-13 than occurs in naturally formed diamond. Tsuji provides a method of synthesizing single diamond crystals using a carbon source containing at least 99.9 atomic percent carbon-12. Tsuji teaches that the carbon source is graphitized to enhance the crystallinity of the carbon prior to synthesizing single diamond crystals as a product via a temperature difference method. Tsuji informs one of ordinary skill in the art that the synthetic diamond made should be free from metallic inclusions and irregular shaped crystals and that a further improvement can be realized if nitrogen impurity is eliminated. See, e.g., column 3, line 2-21 and column 4, line 39 through column 5, line 4 of Tsuji.

The examiner acknowledges that Tsuji does not disclose adding boron into the carbonaceous material or flux (metal solvent) used in forming a synthetic diamond by the method disclosed therein so as to form a boron-doped diamond, as required in appellants' appealed method claims. See answer, page 3.

Anthony (column 1, lines 11 and 12) teaches that using a chemical vapor deposition (CVD) synthetic diamond forming method

typically results in large stress cracks being present in the product. Anthony (column 6, lines 58-62) discloses using boron-doping in such a CVD synthetic diamond manufacturing method to improve oxidation resistance and reduce intrinsic stress in a chemical vapor deposited (CVD) diamond.

The examiner relies on Anthony in combination with Tsuji stating that "it would have been obvious to one of ordinary skill in the art to modify the Tsuji et al process by the teachings of the Anthony et al reference to dope the diamond in order to enhance the properties of the diamond" (answer, page 3).

On this record, we agree with appellants that the examiner has not substantiated why one of ordinary skill in the art would have been led to turn to Anthony's teachings to modify the disparate temperature difference method employed by Tsuji by including boron as an additive for forming diamonds, especially in the face of Tsuji's teachings regarding the avoidance of metal inclusions in the formation of diamonds with high heat resistance by the method disclosed therein. In this regard, the examiner has not substantiated that stress cracking is associated with synthetic diamonds formed by the temperature difference method of Tsuji or that low oxidation resistance was an issue that needed

to be addressed in forming the diamond product of Tsuji by a temperature difference method.

It is well settled that the mere fact that prior art may be modified to reflect features of the claimed invention does not make the modification obvious unless the desirability of such modification is suggested by the prior art. Our reviewing court has repeatedly cautioned against employing hindsight by using the appellants' disclosure as a blueprint to reconstruct the claimed invention from the isolated teachings of the prior art. See, e.g., Grain Processing Corp. v. American Maize-Products Co., 840 F.2d 902, 907, 5 USPQ2d 1788, 1792 (Fed. Cir. 1988). From our perspective, the examiner's proposed combination of the applied references appears to be premised on impermissible hindsight reasoning.

Because the examiner has not presented a prima facie case of obviousness, it follows that we will reverse the examiner's obviousness rejection of method claims 18, 19 and 21.

Our disposition of the examiner's obviousness rejection of product claim 17 is another matter. Product claim 17 is not limited by the process by which it is made. Here, appellants acknowledge that Anthony discloses an isotopically pure diamond

film that is doped with boron in an amount between 1-4,000 parts per million (reply brief, page 2).

Anthony teaches that single diamond crystals may be grown and that the thermal conductivity of isotopically pure diamond may be as high as 33 W/cm-K. See, e.g., column 3, lines 7-28 of Anthony. Anthony teaches that boron can be added to the diamond in an atomic percent amount of between 1-4000 ppm with the most preferred films containing less than 100 parts per million of impurities and intentional additives.[3] See, e.g., column 6, line 58 through column 7, line 1 and column 2, line 68 through column 7, line 1 of Anthony. In this regard, it is well settled that when ranges recited in a claim overlap with ranges disclosed in the prior art, a prima facie case of obviousness typically exists and the burden of proof is shifted to the applicants to show that the claimed invention would not have been obvious. In re Peterson, 315 F.3d 1325, 1329-30, 65 USPQ2d 1379, 1382-83 (Fed. Cir. 2003); In re Geisler, 116 F.3d 1465, 1469, 43 USPQ2d 1362,

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[3] Also, given that the diamond of Anthony is doped with boron, it would reasonably be expected that the boron doped diamond of Anthony would possess the claimed functional characteristic of being a p-type semiconductor. Compare page 3, lines 1-4 of appellants' specification wherein appellants acknowledge that boron doping of diamond results in the doped diamond being a p-type semiconductor.

1365 (Fed. Cir. 1997); In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936-37 (Fed. Cir. 1990).[4]

Appellants (reply brief, pages 2 and 3) seemingly argue that Anthony adds the boron for a different purpose than appellants and refer to Examples on pages 15 and 16 of their specification to apparently suggest that an amount of boron less than 100 parts per million (ppm) would not be suggested by Anthony. However, in reaching the conclusion that the claimed subject matter is prima facie obvious over the combined teachings of the applied references, we also note that the prior art references in question need not provide all of appellants' reasons, such as the alleged high thermoconductivity and semiconducting properties, to establish a prima facie case of obviousness. See In re Kemps, 97 F.3d 1427, 1430, 40 USPQ2d 1309, 1311 (Fed. Cir. 1996) (the motivation to combine features need not be identical to that of appellant to establish a prima facie case of obviousness).

Furthermore, to the extent appellant may have recognized another potential advantage of the claimed diamond that would have arisen by otherwise following the teachings of the prior

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[4] We need not review the teachings of Tsuji because we find that the teachings of Anthony are sufficient to make out a prima facie case of obviousness.

art, that recognition does not necessarily form a basis for patentability. See In re Woodruff, 919 F.2d at 1577-1578, 16 USPQ2d at 1936 (Fed. Cir. 1990). In any event, in the present case, Anthony expressly suggests that the isotopically pure diamond would have higher thermal conductivity than a diamond not possessing that isotopic purity. See, e.g., column 3, lines 20-23 of Anthony. Moreover, appellants acknowledge that it is known that impurity addition to diamond decreases thermal conductivity. Thus employing less than 100 ppm total impurities and additives, such as 5 ppm boron additive, as reasonably suggested in the paragraph bridging columns 6 and 7 of Anthony would have been expected to yield higher thermal conductivities than employing the upper limit of 4,000 ppm boron. As expressed in footnote 3 above, the p-type semiconducting properties are also expected.

To the extent appellants (brief, page 7) are asserting that the examples presented in the specification establish unexpected results for the claimed synthetic diamond, we note that appellants bear the burden of establishing that the claimed subject matter in fact imparts unexpected properties. See In re Klosak, 455 F.2d 1077, 1080, 173 USPQ 14, 16 (CCPA 1972). In our opinion, appellants have not met the burden of establishing that the reported test results set forth in the specification for the

claimed product would have been truly unexpected to a person of ordinary skill in the art given the teachings of Anthony as outlined above.

It is noted that appealed claim 17 is not limited to the specific method of preparing a diamond and to the specific amounts of isotopic purity (99.95% carbon-12) and minimum amount of boron doping 3-4 ppm, as tested. Indeed, no test results for isotopically pure carbon-13, which is within the scope of claim 17, were furnished. Moreover the minimum amount of boron doping within the range claimed (1 ppm) has not been tested in appellants' specification at pages 12-21 and as reported in Tables 2-5. Nor have appellants explained in their briefs how the comparative examples 1-4 (page 15 of the specification) and the results set forth in table 5 (page 15 of the specification) are representative of the closest applied prior art.

Appellants simply have not met the burden of explaining how the results reported in the specification can be extrapolated from the limited instances presented so as to be guaranteed as attainable through practicing the invention as broadly claimed. It is well established that the evidence relied on to establish unobviousness must be commensurate in scope with the claimed subject matter. See In re Kerkhoven, 626 F.2d 846, 851, 205 USPQ

1069, 1072-1073 (CCPA 1980) and In re Clemens, 622 F.2d 1029, 1035, 206 USPQ 289, 296 (CCPA 1980).

Hence, we are not satisfied that the evidence of record offered for comparison demonstrates results that are truly unexpected when compared with the closest prior art and that are commensurate in scope with the claims.

In conclusion, based on the foregoing and the reasons set forth by the examiner, it is our judgment that the evidence of obviousness presented by the examiner outweighs the evidence of nonobviousness advanced by appellants. Accordingly, we shall sustain the examiner's § 103(a) rejection of claim 17.

CONCLUSION

The decision of the examiner to reject claims 18, 19 and 21 under 35 U.S.C. § 103(a) as being unpatentable over the teachings of Anthony and Tsuji is reversed. The decision of the examiner to reject claim 17 under 35 U.S.C. § 103(a) as being unpatentable over the teachings of Anthony and Tsuji is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

CHARLES F. WARREN)
Administrative Patent Judge)
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PETER F. KRATZ) BOARD OF PATENT
Administrative Patent Judge) APPEALS
) AND
) INTERFERENCES
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